

1. A method of automatically calibrating an electronic distance meter (EDM) subsystem of a total station, comprising the steps of:

receiving from at least one orbiting GPS
5 satellite radio signals with timing information controlled by an atomic clock on board said satellite;

providing a global positioning system (GPS) receiver with a navigation computer for maintaining tracking of said radio signals and for deriving precise timing
10 information from said radio signals;

providing a local reference oscillator with a timing signal based on said derived precise time information;

providing the EDM subsystem with a signal from
15 said oscillator wherein said EDM subsystem sends an out-bound laser signal to a distant target and receives an in-bound signal reflected by said target;

measuring a difference between said out-bound signal and said resulting in-bound signal reflected from
20 said distant surveyor target to determine the line-of-sight distance to said target;

wherein, the step of measuring provides a signal time-of-flight measurement with an accuracy derived from said precise timing information in said timing signal and
25 from which a similarly accurate distance-to-target is computed.

2. The method of claim 1 wherein:

the step of measuring is based on a reference time base signal obtained from said local reference oscillator.

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3. The method of claim 2 wherein:

said EDM subsystem includes a transmitter for sending said out-bound signal through a telescope to said distant target and a receiver for receiving said in-bound signal through said telescope.

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4. The method of claim 3 wherein:

the step of measuring includes use of a phase measurement device connected to said reference oscillator, said transmitter and said receiver, wherein said phase measurement device provides said time measurement using said reference time base signal.

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5. The method of claim 1 wherein:

said global positioning system receiver is remotely located to said EDM subsystem, and including the step of,

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communicating via a radio link between said receiver and said EDM subsystem to drive said EDM system with a signal from said oscillator.

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6. The method of claim 4 wherein:

said phase measurement device conducts pulse time-of-flight to determine the line-of-sight distance to said target.

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7. The method of claim 4 wherein:

said phase measurement device conducts carrier phase measurements to determine the line-of-sight distance to said target.

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8. The method of claim 4 wherein:

the step of measuring the time difference includes observations of a plurality of phase differences observed by said EDM subsystem at a plurality of out-bound and in-bound signals.

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9. The method of claim 4 further including:

mounting said telescope to an angle measurement instrument connected to a servo actuator;

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computing in said computer a space vector to target signal;

commanding said servo actuator to direct said telescope towards said target; and

locking in said telescope onto said target.

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10. The method of claim 9 further including:

computing a target location seed representing a current position estimate of said telescope;

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outputting said target location seed as a position estimate to determine an altitude and azimuth vector to said target;

creating a space vector to target signal from said position estimate;

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commanding said servo actuator by said vector to target signal.

11. The method of claim 1 further including:

providing a 1 Hz signal from said GPS receiver
with timing characteristics derived from said atomic clock;
and

5 stabilizing said local reference oscillator by
comparing zero crossings of signals of said local reference
oscillator with zero crossings of said 1 Hz signal.

12. The method of claim 1 further including:

10 providing a first 1 Hz signal from said GPS
receiver with timing characteristics derived from said
atomic clock;

reducing the signal frequency of said local
reference oscillator to a second 1 Hz signal;

15 phase comparing said first and second 1 Hz
signals to provide an error signal;

providing the error signal to a phase control
port in said local reference oscillator; and

20 synchronizing said reference oscillator to said 1
Hz signal from said GPS receiver.

13. A method of automatically calibrating an
electronic distance meter (EDM) subsystem of a total
station, comprising the steps of:

25 receiving from a time-standard broadcast
transmitter source a timing reference signal from which a
first comparison signal is derived;

operating a local reference oscillator at a
particular frequency of operation;

receiving a first signal from said local
reference oscillator and reducing said first signal to a
second comparison signal;

5 phase comparing said first comparison signal with
said second comparison signal to provide an error signal;

processing said error signal to create a control
signal to provide to said local reference oscillator to
obtain phase synchronization of said local reference
oscillator with said time-standard broadcast transmitter
10 timing reference signal; and

providing the EDM system with a synchronized
reference signal from said local reference oscillator.

14. The method of claim 13 wherein:

15 said EDM subsystem further provides an out-bound
signal directed towards a distance target, and receives an
in-bound signal reflected by said target;

measuring a difference between said out-bound
signal and said resulting in-bound signal reflected from
said distant target to determine the line-of-sight distance
20 to said target; and

wherein the step of measuring provides a signal
time-of-flight measurement with an accuracy derived from
said time standard broadcast transmitter and from which a
25 similarly accurate distance-to-target estimate is computed.

15. The method of claim 13 wherein:

said time-standard broadcast transmitter source
includes a receiver tuned to receive and synchronized to
30 time data broadcast from NIST via short-wave radio.

16. The method of claim 13 wherein:

said time-standard broadcast transmitter source includes a receiver to receive alternate timing signals and to synchronize said time-standard broadcast transmitter to said alternate timing signals, wherein said alternate timing signals are provided from a second time reference station drawn from the group of WWV in Fort Collins, Colorado or WWVH in Hawaii.

17. The method of claim 13 wherein:

said time-standard broadcast transmitter includes an orbiting GPS satellite.

18. The method of claim 1 further including the step of:

computing in said navigation computer a current three-dimensional position of the EDM subsystem.